

Maintenance procedures

DTI commands (LD 60)

DTI diagnostic commands are used to maintain both DTI and Clock Controller operation. The commands are organized as follows:

- card and channel commands (Table 3)

Table 3
Card and channel commands (Part 1 of 3)

Command	Description
DISI L	DTI loop L is disabled only when all the channels are idle. The network and DTI card are then disabled and status LEDs are lit. Channel status is set to busy. Enter END to abort.
DISL L	Disables network and DTI card of loop L. Active calls are force disconnected by on-hook simulation. All channels are disabled. Status LEDs DIS and RED (on QPC720) are lit.
DSCH L CH	Channel CH of DTI loop L is disabled.
ENCH L CH	Channel CH of DTI loop L is enabled. Channels other than TIE trunks are set to idle. TIE trunks are set to the same state as the far end (as presented by the T1 port).
ENLL L	Enables DTI loop L. Channel CH of DTI loop L is enabled. Channels other than TIE trunks are set to idle. TIE trunks are set to the same state as the far end (as presented by the T1 port).
STAT	Prints the status of all digital loops. The types are PRI (Primary Rate Interface), DTI (Digital Trunk Interface), and DLI (Digital Link Interface).

Table 3
Card and channel commands (Part 2 of 3)

Command	Description
STAT L	Prints status of DTI loop L. Refer to STAT L CH for channel status format. Loop status may be as follows:
DTI TRK LOOP L	Network loop L is configured as a DTI trunk.
DSBL	DTI hardware is disabled.
ENBL	DTI hardware is enabled.
RLBK	DTI hardware is in remote loopback mode.
DISI PENDING	DISI command (disable when idle) is in progress.
SERVICE RESTORE:	
YES	Loop will restore service automatically if alarm condition is removed.
NO	Loop can only be manually enabled.
TRACKING	System clock is tracked to this loop.
YELLOW ALARM PROCESS:	
YES	Yellow alarm (remote alarm) processing is enabled.
NO	Yellow alarm (remote alarm) processing is disabled.
ALARM STATUS:	
NO ALARM	No alarm active.
RED	Red alarm (local alarm) active. May have T1 transmission problem. Action: 1 List alarm counters (LCNT L command). 2 Look for DTA messages. 3 Go to the fault clearing chapter.
YELLOW	Yellow alarm (remote alarm) active. The far end is not ready or in local alarm mode.

Table 3
Card and channel commands (Part 3 of 3)

Command	Description										
	WAITING DTI hardware is not responding. The card either did not respond to a status check or did not respond when a red alarm (local alarm) was cleared. Action: 1 Check DTI status again. 2 Disable then enable the DTI card (DISL L and ENLL L commands).										
STAT L CH	Prints status of channel CH for DTI loop L. Status may be as follows: <table><tr><td>IDLE</td><td>Channel is enabled and is idle.</td></tr><tr><td>BUSY</td><td>Channel has an active call, or channel is in a lockout state (the far end is disabled).</td></tr><tr><td>MBSY</td><td>Channel is maintenance busy. The associated channel on the far end is disabled.</td></tr><tr><td>DSBL</td><td>Channel is disabled.</td></tr><tr><td>UNEQ</td><td>Channel is not equipped. DTI channels are 1-24.</td></tr></table>	IDLE	Channel is enabled and is idle.	BUSY	Channel has an active call, or channel is in a lockout state (the far end is disabled).	MBSY	Channel is maintenance busy. The associated channel on the far end is disabled.	DSBL	Channel is disabled.	UNEQ	Channel is not equipped. DTI channels are 1-24.
IDLE	Channel is enabled and is idle.										
BUSY	Channel has an active call, or channel is in a lockout state (the far end is disabled).										
MBSY	Channel is maintenance busy. The associated channel on the far end is disabled.										
DSBL	Channel is disabled.										
UNEQ	Channel is not equipped. DTI channels are 1-24.										

— test commands (Table 4)

Table 4
Test commands

Command	Description
ATLP 1/0	Automatic loop test enable (=1) or disable (= 0). 1 = Loop test enable; this will cause the far end to raise and clear a yellow alarm (remote alarm). 0 = Run the partial loop test; there is no interaction with the far end loop (default value).
RLBK L	Closes the loop at the carrier interface point of the DTI so the far end can perform an external loopback test. DTI loop L must be disabled because the test disrupts call processing.
DLBK L	Disables the remote loopback test previously set by RLBK L. The loop remains disabled.
DLBK L CH	Disables the remote loopback test previously set by RLBK L CH. The channel remains disabled.
RLBK L CH	Same as RLBK L, but performed on a specified channel CH. This channel must be disabled before issuing the request.
RMST L	Performs self-test on loop L, providing the far end is in the remote loopback mode.
SLFT L	Invokes DTI self-test on loop L. The loop must be disabled because the test disrupts call processing.
SLFT L CH	Invokes partial DTI hardware self-test using channel CH of loop L.

— alarm and counter commands (Table 5)

Table 5
Alarm and counter commands

Command	Description																
CDSP	Clears the maintenance display on active CPU to 00 or blank.																
CMIN C	Clears the minor alarm indicator for customer C.																
CMIN ALL	Clears the minor alarm indicators for all customers.																
LCNT	Prints content of all alarm counters of all DTI loops.																
LCNT L	Prints content of all alarm counters of DTI loop L. The counters are as follows: <table> <tr> <td>BPV</td><td>Bit error rate counter indicates both bipolar violation and ESF CRC counts (the latter only if configured in ESF mode)</td></tr> <tr> <td>SLIPD</td><td>Frame slip deletion counter</td></tr> <tr> <td>SLIPR</td><td>Frame slip repetition counter</td></tr> <tr> <td>CRC</td><td>Cyclic Redundancy Check (CRC) in DTI always shows 0 if configured in ESF mode</td></tr> <tr> <td>LOSFA</td><td>Loss of frame alignment counter</td></tr> <tr> <td>OS_BPV</td><td>24-hour bit error rate counter</td></tr> <tr> <td>OS_LOS F</td><td>24-hour loss of frame alignment counter</td></tr> <tr> <td>OS_YEL</td><td>24-hour yellow alarm (remote alarm) counter</td></tr> </table>	BPV	Bit error rate counter indicates both bipolar violation and ESF CRC counts (the latter only if configured in ESF mode)	SLIPD	Frame slip deletion counter	SLIPR	Frame slip repetition counter	CRC	Cyclic Redundancy Check (CRC) in DTI always shows 0 if configured in ESF mode	LOSFA	Loss of frame alignment counter	OS_BPV	24-hour bit error rate counter	OS_LOS F	24-hour loss of frame alignment counter	OS_YEL	24-hour yellow alarm (remote alarm) counter
BPV	Bit error rate counter indicates both bipolar violation and ESF CRC counts (the latter only if configured in ESF mode)																
SLIPD	Frame slip deletion counter																
SLIPR	Frame slip repetition counter																
CRC	Cyclic Redundancy Check (CRC) in DTI always shows 0 if configured in ESF mode																
LOSFA	Loss of frame alignment counter																
OS_BPV	24-hour bit error rate counter																
OS_LOS F	24-hour loss of frame alignment counter																
OS_YEL	24-hour yellow alarm (remote alarm) counter																
LOVF C R	Lists threshold overflows for the customer and the route specified. The overflows are set when the resident trunk monitor outputs a diagnostic message. Defined thresholds are HOLD, ILLR, REPT, SEIZ and SVFL (see LD 16).																
RSET L CH	Resets the thresholds for DTI loop L, trunk channel CH.																
RCNT	Resets all alarm counters of all DTI loops.																
RCNT L	Resets all alarm counters of DTI loop L.																

Note: The DTI interface requires a QPC472 DTI or QPC720 Primary Rate Interface (PRI) card. Since this document deals with DTI functions, both cards are referred to as the “DTI” card or “DTI” hardware whenever their functionality is identical.

Self-test

The self-test, also called a local loopback test, checks speech path continuity, zero code suppression, remote alarm detection, and A&B bit signaling. This test is performed manually, on a per channel or a per frame (24 channels) basis.

The DTI card must be disabled before performing the self-test or call processing will be disrupted. To perform the self-test on a specific loop, use the following commands:

```
LD 60  
DISL L  
SLFT L
```

Automatic loop test

The automatic loop test checks the same functions as the self-test. Unlike the self-test, it can be run automatically, as part of the midnight routines.

With the ATLP command set to 1, the following occurs:

- 1 If all 24 channels are idle at midnight, Meridian 1 software disables the card and performs a self-test on all channels.
- 2 If any of the 24 channels are busy at midnight, Meridian 1 software disables one channel, chosen at random, and checks it while the pack is enabled.

With the ATLP command set to 0, the following occurs:

- 1 Only one channel is tested.
- 2 The channel tested is randomly selected by software; it cannot be specified.
- 3 The test is performed whether the channel is in a busy or idle state.

To perform the remote loopback test, use the following commands:

```
LD 60
ATLP 1 or 0
```

Link diagnostic and remote loopback tests

The remote loopback test and the link diagnostic test are performed manually on a per channel or a per frame (24 channels) basis.

Link diagnostic test The link diagnostic test, also called the far end loopback test, does not test the Meridian 1 DTI. It puts the DTI in loopback mode so a remote loopback test can be performed on equipment at the far end.

The DTI channel or frame being tested must be disabled before performing the link diagnostic test, or call processing will be disrupted.

Remote loopback test The remote loopback test, also called the near end loopback test, checks the integrity of the DTI link from the Meridian 1 to the far end. The far end must be in loopback mode before this test can be performed.

The DTI channel or frame being tested must be disabled before performing the remote loopback test, or call processing will be disrupted.

Coordinating the tests When a technician at the far end is asked to place his or her DTI in loopback mode (the link diagnostic test), the technician issues the following commands in LD 60:

```
LD 60
DISL L
RLBK L
```

To run the remote loopback test on the near end (local) Meridian 1, do the following:

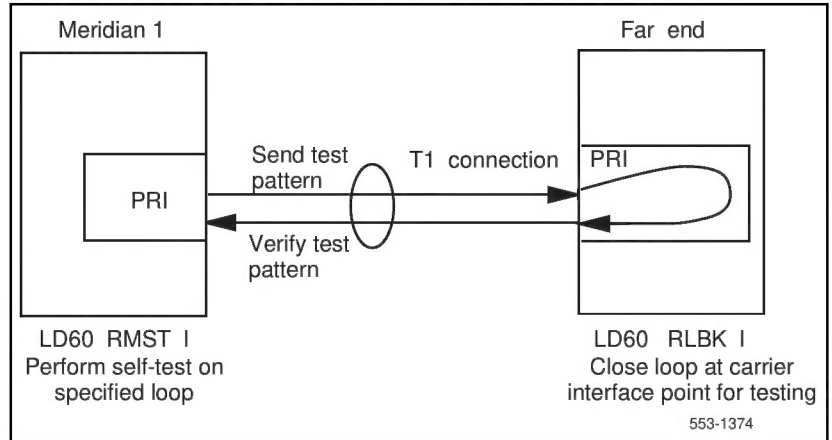
- 1 Call a technician at the far end. Ask for loopback mode at that facility.
- 2 When loopback mode at the far end is confirmed, the technician at the local end and issues the following commands in LD 60:

```
LD 60
DISL L
RMST L
```

After a brief time, there is an “OK” message.

Figure 2 shows the relationship between the remote loopback test and the link diagnostic test.

Figure 2
DTI remote loopback test and DTI link diagnostic test



DTI system messages

There are two types of system messages—DTA messages (PRI/DTI alarm messages) and DTI messages (DTI/PRI error messages). See Table 6 for DTA messages; Table 7 lists DTI messages.

Table 6
PRI/DTI alarm messages (Part 1 of 2)

Message	Description
DTA001 L	Data block is not defined.
DTA002 L	Message received with wrong chip field.
DTA003 L	Power up message received.
DTA004 L	Phase lock loop (PLL) clear message is received without phase lock loop alarm.
DTA005 L	Yellow alarm (remote alarm) has occurred.
DTA006 L	Yellow alarm (remote alarm) 24-hour threshold has been exceeded. Manual intervention is required.
DTA007 L	Yellow alarm (remote alarm) is cleared.
DTA008 L	Yellow alarm (remote alarm) is disabled.
DTA009 L	Phase lock loop alarm has occurred.
DTA010 L	Phase lock loop alarm has cleared.
DTA011 L	Bit error rate warning threshold.
DTA012 L	Bit error rate out of service limit.
DTA013 L	Too many bit error rate out of service occurrences in 24 hours.
DTA014 L	Bit error rate alarm cleared.
DTA015 L	Frame slip—tracking—maintenance limit.
DTA016 L	Frame slip—tracking—out of service limit.
DTA017 L	Frame slip—free run (non-tracking)—maintenance limit.
DTA018 L	Frame slip—free run (non-tracking)—out of service limit.

Table 6
PRI/DTI alarm messages (Part 2 of 2)

Message	Description
DTA019 L	Frame alignment maintenance limit.
DTA020 L	Frame alignment out of service limit.
DTA021 L	Frame alignment alarm persisted for 3 seconds.
DTA022 L	Frame alignment alarm has cleared for at least 15 seconds.
DTA023 L	PRI loop is up.
DTA024 L	System initiated (automatic, LD 45, or LD 60) self-test on PRI loop L failed. All channels are disabled. Loop is put into red alarm (local alarm).
DTA025 L	System initiated (automatic, LD 45, or LD 60) self-test on PRI loop L passed. Channels were previously disabled because of self-test fault or a loop-level self-test. Channels are enabled and red alarm (local alarm) is removed.
DTA026	Frame slip—free run (non-tracking)—out of service limit is reached. Trunks remain out of service. Reset improvement timer.
DTA028	Frame slip rate—free run (non-tracking)—improvement criterion is not met. Keep trunks out of service. Restart the improvement timer.
DTA029	Frame slip rate—free run (non-tracking)—improvement criterion is met. Bring trunks back into service.

Table 7
DTI/PRI error messages (Part 1 of 8)

Message	Description
DTI000	LD 60 identifier.
DTI001	Invalid input character.
DTI002	Invalid command.
DTI003	Incorrect number of parameters.
DTI004	Incorrect customer number.
DTI005	Invalid parameter.
DTI006	Loop specified is not a DTI/PRI loop.
DTI007	DISI request already active.
DTI008	DISI command is completed.
DTI009 loop ch	DTI/PRI channel failed hardware self-test. For DTI009 L M E, the output data is as follows: L = loop M = N for NI microprocessor (see Table 7.1) M = C for CI microprocessor (see Table 7.2) E = error code for debug purposes.

Table 7
DTI/PRI error messages (Part 2 of 8)

Message	Description
	Table 7.1—Error codes for NI microprocessor (M=N) 00 = NI self-test has finished. 01 = Undefined messout received. 02 = Problem with group 2 error handling (invalid level). 03 = NI to CI FIFO full (128 messages lost). 04 = CI-1 Micro failed to initialize on power-up. 05 = NI group 1 error handling - undefined condition found. 06 = Bad MESSOUT number 6 encountered. 07 = NI messout queue fails. 08 = NI messin queue full. 09 = NI priority messin queue is full. 10 = Bad MESSOUT number 10 encountered. 11 = TN = 0 read from regular queue. 12 = TN = 0 read from priority queue. 14 = Bad TN associated with MESSOUT number 4. 15 = Bad TN associated with MESSOUT number 15. 50 = External RAM in range 880h-8EFH failed (MESSIN queue). 51 = Internal RAM test failed. 52 = Pad RAM test failed. 53 = External RAM test failed. 54 = 8253 timer/counter test failed. 55 = Slip counter test failed. 56 = Loopback of TS16 frame 0 failed. 57 = Loopback of non fas TSO failed. 58 = Echo test to CI-1 micro failed. 255 = Loss of NI FIFO synchronization (Stop byte = 0 not found).

Table 7
DTI/PRI error messages (Part 3 of 8)

Message	Description
Table 7.2—DTI009 error codes for CI microprocessor (M=C)	
	03 = A complete message was not received from NI micro. 128 = Message received by CI-1 through FIFO requested an undefined task. 129 = Message number 26 contained more than one bit set to indicate which of the ABCD bits is to be used for PPM. 130 = An attempt was made to set the flag to invoke the pulse timer for TS 0. 131 = A request for a task defined under messout 30 has been received with the TN of TS 0. 132 = Attempt was made to enable outputting TS0 or TS16. 133 = A messout 31 has been received for TS 0 or TS 16 with the pulse hold time not = 0. 134 = An attempt has been made to set the bit to invoke the pulse timer for TS 0 or TS 16. 135 = A request for outputting was received, but outputting data was not downloaded. 137 = A request for PPM counting was received, but the counting data was not downloaded. 138 = A messout 30 was received requesting a task to be performed for DTI TS 16, which is not allowed. 139 = The 8031 on CHIP RAM failed self-test. 140 = The TS 16 signalling RAM and/or the TS 16 pick up buffer failed self-test. 141 = The CI-1 micro external RAM failed self-test. 142 = An attempt was made to set/clear the flag used to invoke PPM pulse timing for DTI timeslot 0 or 16. 143 = CI-2 micro responded to echo request message, but response was in error. 144 = CI-2 micro failed to respond to request echo message. 145 = SL1 TN of MESSOUT received is not 0 0 7 3 (self-test). 146 = The TN of MESSOUT 26 received was not that of TS 0. 147 = The TN of MESSOUT 28 received was not that of TS 0. 148 = The TN of MESSOUT 29 received was not that of TS 0. 149 = Upon enabling the DTI pack, the CI-1 was unable to write Frame 0, TS 16 with "0B." 150 = MESSOUT 26 was received with the PPM counting bit (abcd) all equal to zero.

Table 7
DTI/PRI error messages (Part 4 of 8)

Message	Description
	151 = MESSOUT 28 was received with the outputting bit (abdc) equal to zero. 152 = CI-2 failed to respond to the CI-1 watchdog message. 153 = The CI-2 failed to respond to five consecutive watchdog messages and is assumed to be out of service. 154 = MESSOUT received requesting the lower nibble of MFAS pattern to be written with something other than "0000." 155 = MESSOUT received requesting '0000' to be written into 'abdc' state. 156 = MESSOUT received with a TN outside the range shelf 0, card 8-1, unit 3-0. 157 = CI-1, NI FIFO overflowed and has been cleared. 128 messages lost.
DTI010 loop c	System clock c cannot be switched in to replace active clock; or another loop is already in loopback mode.
DTI011 c	System clock c cannot be switched in because loss of service will result to the peripheral signaling pack listed.
DTI012 loop	Network card does not respond from IOTEST; loop is disabled.
DTI013 loop	No channel is available on loop for diagnostic test. No self-test is performed on this loop.
DTI014 loop	Loop is in remote loopback mode; command not allowed.
DTI015 loop	Loop is not specified as primary or secondary clock reference source.
DTI016	The DTI package is not equipped; LD 60 is not allowed to load.
DTI017	Previous command in progress; enter END to abort.
DTI018 loop	DISI command aborted.
DTI019	The loop/channel is not disabled for self-test or it is already in the requested set/reset loopback mode.
DTI020 loop	Loop is already disabled. No action is taken.
DTI021	Attempt was made to disable input TTY loop.
DTI022 loop	Loop is already enabled or the Peripheral Signaling card is disabled.
DTI023 loop ch	Cannot disable/enable the specified channel.

Table 7
DTI/PRI error messages (Part 5 of 8)

Message	Description
DTI024	Loop is enabled but no response from hardware.
DTI025 loop ch	Terminal is not equipped.
DTI026 c r	Invalid input parameter to LOVF command for customer c, route r.
DTI027 loop	Loop is not in loopback test mode.
DTI028 loop ch	No test result received before timeout from the specified loop or channel.
DTI029 loop	Loop is enabled but red (local) and yellow (remote) alarms exist.
DTI030 loop	Loop is enabled but red alarm (local alarm) exists.
DTI031 loop	Loop is enabled but yellow alarm (remote alarm) exists.
DTI032 loop	Loop is in yellow alarm (remote alarm) state or is waiting for "yellow alarm sending ceased" message from hardware. Do not perform the automatic self-test.
DTI033 loop	Loop is in red/yellow/audit state. Command not allowed.
DTI034 loop	Switching of clock controller is not allowed for this machine type.
DTI034 loop m	Loop microprocessor m failed echo message self-test; m = N for NI microprocessor and m = C for CI microprocessor.
DTI035	Clock Controller does not exist.
DTI035 loop ts	Network map in software indicates that timeslot ts of network loop is idle but the connection memory word for that slot on network pack is not idle. Probably a software fault.
DTI036 loop	Continuity checker on loop is faulty. Network pack probably faulty.
DTI037 loop	Unable to read partial alarm counts from DTI hardware on loop. Following alarm counts are not complete.
DTI038 loop	No channel is available on loop for diagnostic. Self-test was not performed.
DTI038 loop	Loop not responding. Check enable switch on Network card (P1).
DTI039 loop	Continuity test failed on loop.

Table 7
DTI/PRI error messages (Part 6 of 8)

Message	Description
DTI040 loop ch	Loopback test failed on loop and channel.
DTI041 loop	Network memory test failed. Replace network pack.
DTI042 loop ch	No timeslots available for loopback test. Loopback test not tested on channel. If loop level test, all channels greater than and including channel ch not tested.
DTI043	Another channel already in loopback mode.
DTI044 loop	Loop enabled by midnight routine.
DTI045 loop	Self-test not performed on loop because loop was disabled manually.
DTI046 loop	Self-test not performed on loop because unable to access the loop.
DTI047 loop	Self-test not performed on loop since loop in remote loopback mode.
DTI050 loop	Continuity checker on loop is faulty. The network pack is probably faulty.
DTI051	Data link is not defined.
DTI052	Tracking rejected. Reference primary is not specified.
DTI053	Unable to track on primary.
DTI054	Tracking rejected. Reference secondary is not specified.
DTI055	Unable to track on secondary.
DTI056	Unable to access clock controller.
DTI057	Unable to free run.
DTI058	Supposed to free run but hardware is tracking on primary.
DTI059	Supposed to free run but hardware is tracking on secondary.
DTI060	Supposed to track on primary but hardware is tracking on secondary.
DTI061	Supposed to track on primary but hardware is free run.
DTI062	Supposed to track on secondary but hardware is tracking on primary.

Table 7
DTI/PRI error messages (Part 7 of 8)

Message	Description
DTI063	Supposed to track on secondary but hardware is free run.
DTI064	Cannot determine which CPU is in use.
DTI065	System clock must be switched before proceeding.
DTI066	Idle CPU must be switched in for active CPU before proceeding.
DTI067 c	System clock generator specified is already enabled.
DTI068 c	System clock generator specified is not responding.
DTI069 loop	Unable to track on loop.
DTI070	Clock cannot be switched. Unable to track the reference loop.
DTI071	The ENCH L C command is not allowed here because the channel is busy.
DTI072	The ENCH L C command is not allowed because the associated D-channel is not established.
DTI073 loop	If loop is a QPC720, then the pack is not responding. If loop is a QPC472, then ignore this message.
DTI081	B-channel cannot be enabled until a DCH Link is established.
DTI098	Command entered applies to 1.5 Mb DTI only.
DTI099	Command entered applies to 2.0 Mb DTI only.
DTI100 loop	DTI link loop is associated with an indirect command and Status Link. This loop cannot be disabled until the CSL is disabled.
DTI101	Server using channel for maintenance, cannot Remove Link.
DTI202 L	DTI loop with line coding method of B8ZS cannot be enabled because it requires a QPC720 pack. Replace a QPC472 with a QPC720.

Table 7
DTI/PRI error messages (Part 8 of 8)

Message	Description
DTI203 L	DTI loop with Extended Super Frame (ESF) cannot be enabled because it requires a QPC720 pack. Replace a QPC472 with a QPC720.
DTI4130	Incompatible protocol between the interfaces. If this error continues, report it.
DTI4131	Incompatible protocol between the interfaces. If this error continues, report it.
DTI4132	ENCH L C command is not allowed because the associated D-channel is not established.

DTI error detection

Bit error rates

Bit error rate monitoring detects errors in transmission.

There are two methods of bit error rate monitoring: bipolar violation tracking and cyclic redundancy checks. With D2, D3, or D4 framing formats, only bipolar violation tracking is performed. With the Extended Superframe (ESF) framing format, cyclic redundancy checks are performed.

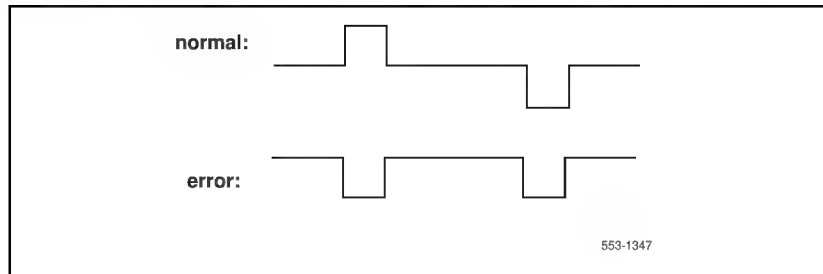
Framing format is defined in these commands:

LD 17

DLOP

Bipolar violations (BPV) In a bipolar pulse stream, pulses alternate in polarity. If, after transmission, two pulses of the same polarity are received in succession (this could be caused by an electrical disturbance, such as noise), a bipolar violation has occurred. See Figure 3.

Figure 3
Bipolar violations



Cyclic redundancy check (CRC) The Extended Super Frame (ESF) format contains a check sum of all the data in the frame. The receiving side uses the checksum to verify the data is correct.

The primary difference between BPV and CRC is that bipolar violations indicate errors on the local span, while CRC indicates errors on an end-to-end span. For example, on a satellite link, BPV only detects errors in the span between the Meridian 1 and the satellite connection. Since CRC traverses the entire span, it indicates an end-to-end bit error rate.

In DTI mode with ESF framing format, the bit error rate checking is done as CRC. In DTI mode with D2, D3, or D4 framing formats, CRC error checking is not used.

Bit error rate thresholds DTI hardware detects BPV or CRC errors. It sends an overflow (OVFL) message to the Meridian 1 CPU each time 1024 BPV or CRC errors are detected. Running the midnight routines prints the number of overflows and clears the counter.

There are three bit error rate thresholds set in LD 73. When a threshold is reached, a DTA message is output. See Figure 4.

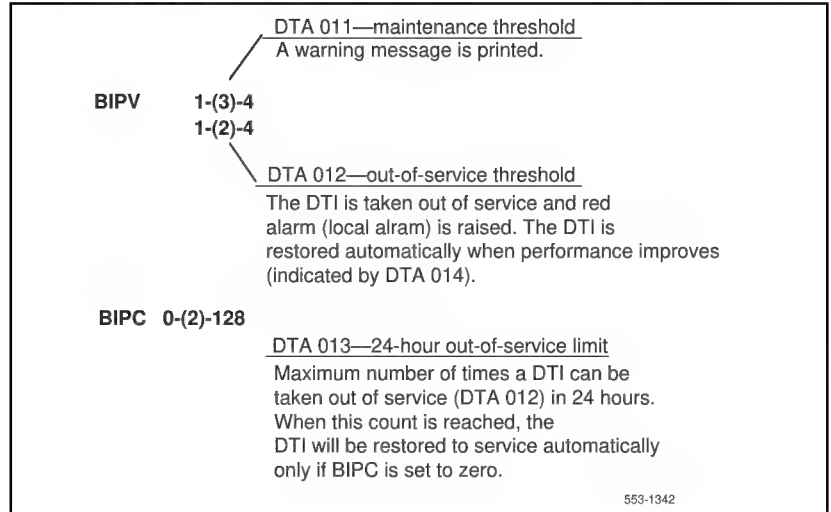
DTA011: Bit error rate maintenance threshold.

DTA012: Bit error rate out-of-service limit.

DTA013: Too many bit error rate out-of-service occurrences in 24 hours.

Note: Automatic restoration is available with Release 11 or later software.

Figure 4
BIPV and BIPC thresholds



The BIPV thresholds are based on the number of errors that occur in a given time. The BIPV threshold levels are shown in Table 8.

Table 8
BIPV thresholds

Level	Error rate	Elapsed time (seconds)
1	$>10^{-3}$	0.6639
2	$>10^{-4}$	6.639
3	$>10^{-5}$	66.39
4	$>10^{-6}$	663.9

For example, a level 3 error means that the error rate on the received transmission has exceeded one error in 100,000. Furthermore, this corresponds to no errors within a 66.39 second window of time.

Frame slip

Digital signals must have accurate clock synchronization for data to be interleaved into or extracted from the appropriate timeslot during multiplexing and demultiplexing operations. Monitoring frame slips detect frame deletion and repetition errors in clock synchronization.

Clock synchronization can be either tracking, on a primary or secondary reference clock, or free run (non-tracking). In LD 73 (prompts PREF and SREF), one DTI may be defined as the primary clock reference. Another may be defined as the secondary clock reference. All others are defined as free run.

Tracking mode DTI hardware detects frame slips in a tracking reference clock. Running the midnight routines prints the number of frame deletions and repetitions and clears the counters.

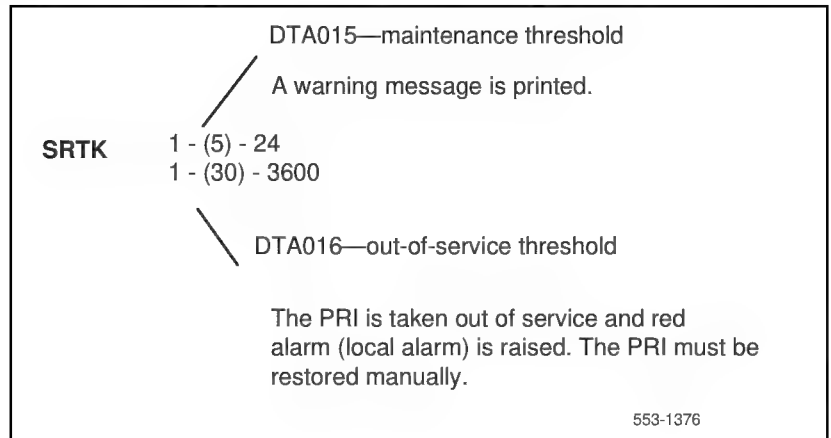
There are two thresholds set in LD 73. See Figure 5. When a threshold is reached, a DTA message is output as shown below.

DTA015: Maintenance limit for frame slips in tracking mode. The default is 1 slip in 5 hours.

DTA016: Out-of-service limit for frame slips in tracking mode. The default is 30 slips in 1 hour.

Free run (non-tracking) mode. DTI hardware detects frame slips in the free run mode. Running the midnight routines prints the number of frame deletions and repetitions and clears the counters.

Figure 5
DTA messages



A maintenance threshold is set in LD 73. An out-of-service threshold is also selected in LD 73. When these thresholds are reached, DTA messages are output as shown below and illustrated in Figure 6:

DTA017: Maintenance limit for frame slips in free run (non-tracking) mode. The default is 10 slips in 15 seconds.

DTA018: Out-of-service limit for frame slips in free run (non-tracking) mode. The default is 10 slips in 3 seconds.

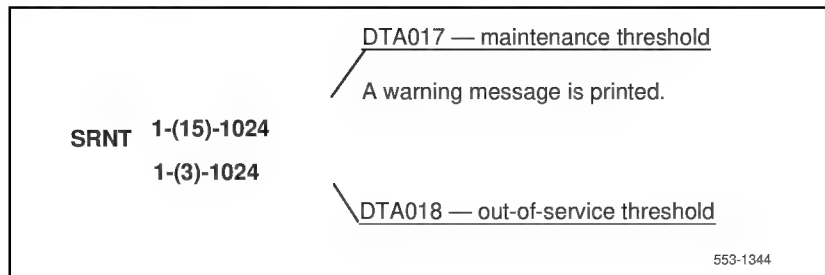
Note: With Release 12 and later software, an option for automatic recovery and an automatic recovery guard timer can also be set in LD 73.

DTA026: Frame slip—free run (non-tracking)—out-of-service limit is reached. Trunks remain out of service. Reset improvement timer.

DTA028: Frame slip rate—free run (non-tracking)—improvement criterion is not met. Keep trunks out of service. Restart the improvement timer.

DTA029: Frame slip rate—free run (non-tracking)—improvement criterion is met. Bring trunks back into service.

Figure 6
DTA thresholds



Frame alignment

Loss of frame alignment monitoring detects out-of-frame conditions on the DS-1 bit stream.

Loss of frame alignment thresholds. DTI hardware detects out-of-frame conditions. Running the midnight routines prints the number of loss of frame alignment occurrences and clears the counters.

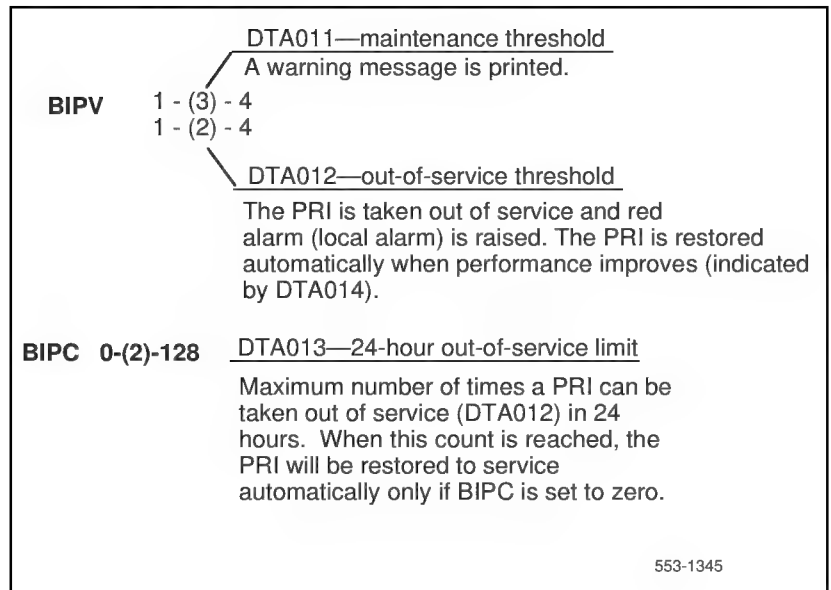
There are three frame alignment thresholds set in LD 73. See Figure 7. When a maintenance or out-of-service threshold is reached, a DTA message is output as shown below:

DTA019: Frame alignment maintenance limit

DTA020: Frame alignment out-of-service limit

Note: Automatic restoration is available with release 11 or later software.

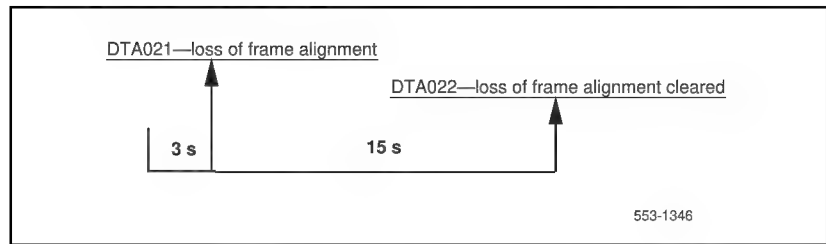
Figure 7
Frame alignment thresholds



If a loss of frame alignment condition persists for three seconds, the affected DTI loop is taken out of service and a red alarm (local alarm) is raised. If the loss of frame alignment condition clears for at least 15 seconds, the DTI is automatically restored to service. The following DTA message is generated.

DTA021: Loss of frame alignment has persisted for 3 seconds. See Figure 8.

Figure 8
Loss of frame alignment



Using the Error Counter

The Error Counter detects bipolar violations or no-signal periods. It counts, stores, and displays them to a maximum of 9999.

The DTI fault detection and isolation procedures described in this chapter are performed using an Option 81 portable test package, which consists of one each of the following items:

- Option 81 TTT2028 Mini-Error Counter, plus operation instruction card
- cord equipped with a bantam plug at one end and minihooks at the other
- loopback plug (shorts pins 3 to 1 and 11 to 9 of a 15 pin D connector)

Follow these steps to use the Error Counter:

- 1** Plug one end of a patch cord into the input jack of the test telephone.

CAUTION

To prevent injury from voltage on the span, always connect the patch cord into the test telephone before connecting the other end to the external signal source.

- 2** Plug the other end of the patch cord into the monitor jack (RCV and XMT) of the QPC720 PRI or the apparatus associated with the QPC472 DTI being tested.
- 3** Monitor the Error Counter LED indicators described on the following page.

Error Counter switch functions

See Table 9 for Error Counter switch functions.

Table 9
Error Counter switch functions

Switch	Function
Display Enable	When held down, the switch enables the Counter display and the GOOD and O/R LED displays.
Reset	Zeros the counter.
Error/Error	Selects error counting seconds for bipolar violations or error-seconds.

Error Counter display functions

Table 10 lists display functions for the Error Counter.

Table 10
Error Counter display functions

Display	Function
GOOD	Indicates the presence of an acceptable bipolar signal. (If bipolar violations, missing pulses, or an oscillating line are detected, the indicator is off.)
ERR	Flashes when bipolar violations are detected.
W/M	Indicates no input (absence of pulse) or an oscillating line.
O/R	Over range display turns on when the counter input has exceeded 9999. (The counter resets to 0000.)
CNTR	With Error/Error-Second switch in the Error position, the unit counts errors at a maximum rate of 200 per second. With Error/Error-Second switch in the Error-Second position, the unit counts error seconds at a rate of one per second.

Replacing the DTI card

CAUTION

Firmly touch the metal frame of the cabinet to discharge static electricity from your body before handling cards.

- 1 Disable the DTI loop:
LD 60
DISL L
- 2 Disconnect cables on the DTI faceplate.
- 3 Remove the DTI from the shelf.
- 4 Ensure that the new DTI card switch settings are the same as for the faulty DTI pack.

Figure 9 shows switch locations for the QPC720 and QPC472 cards. Tables 11 through 13 list transmission equalization switch settings for DTI.

Table 11
QPC720 transmission equalization SW2 switch settings for PRI/DTI

Switch S2 settings	To repeatered facility	To cross-connect point
5 ON	0 - 45 m (0 - 150 ft.)	0 - 30 m (0 - 100 ft.)
2, 4, 6 ON	46 - 135 m (151 - 450 ft.)	31 - 100 m (101 - 355 ft.)
1, 3, 7 ON	136 - 225 m (451 - 750 ft.)	101 - 200 m (356 - 655 ft.)

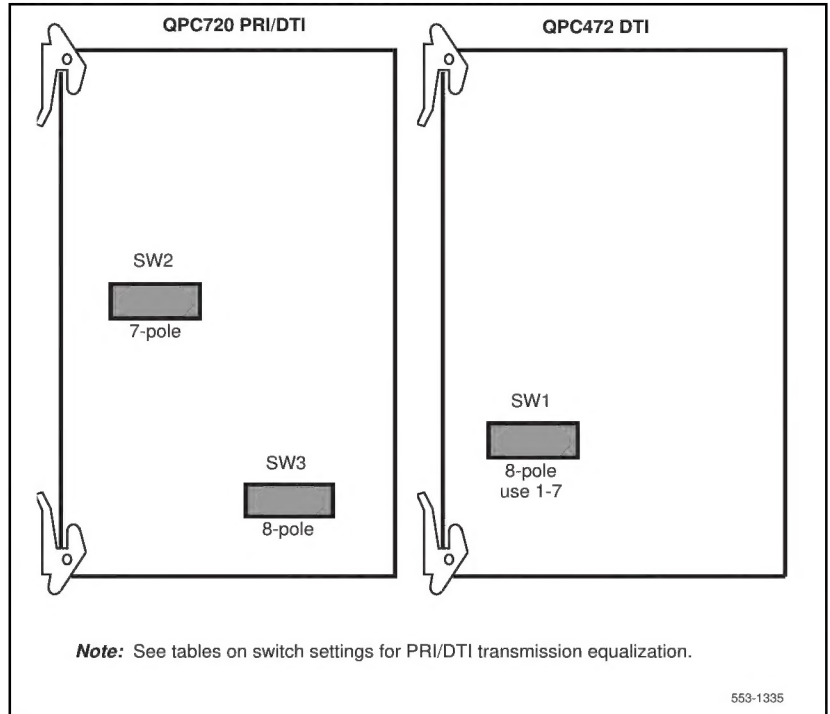
Table 12
QPC472 transmission equalization SW2 switch settings for DTI

Switch S2 settings	To repeated facility	To cross-connect point
5 ON	0 - 45 m (0 - 150 ft.)	0 - 15 m (0 - 100 ft.)
2, 4, 6 ON	46 - 135 m (151 - 450 ft.)	16 - 100 m (101 - 355 ft.)
1, 3, 7 ON	136 - 225 m (451 - 750 ft.)	101 - 200 m (356 - 655 ft.)

Table 13
Transmission equalization switch settings for QPC720 PRI/DTI mode

Switch S2 settings	To repeated facility	To cross-connect point
5 on	0–45 m (0–150 ft)	0–30 m (0–100 ft)
2, 4, 6 on	46–135 m (151–450 ft)	31–100 m (101–355 ft)
1, 3, 7 on	136–225 m (451–750 ft)	101–200 m (356–655 ft)
Switch 3 option for DTI with ESF SW3–1 on = extended superframe format (ESP) off = superframe format (SF)		
Note 1: All positions on S2 (location B22) are OFF except as shown under the column labeled “Switch S2 settings.” Note 2: The switch 3 option for DTI with ESF applies to only X11 release 16, 17, and 18. All other positions on the 8-pole SW3 (location E37) should be OFF. Note 3: Prior to X11 release 19 (releases 16, 17, and 18), you must set the framing format as ESF with the DLOP prompt in LD 17 before you set SW3–1 on the card for the DTI with ESF option. Note 4: Beginning with X11 release 19, framing format, line encoding, and method of yellow alarm are selectable for both DTI and PRI in LD 17 with the DLOP, LCMT, and YALM prompts. All SW3 switch positions should be OFF.		

Figure 9
Transmission equalization switch settings



- 5 Install the new DTI card in the appropriate slot.
- 6 Connect the network loop cable, the carrier interface cable, and the Echo Cancellor cable. If the DTI pack is defined as a primary or secondary clock source, connect the Clock Controller cable(s). See Figures 3 and 4.
- 7 Test the DTI card:
LD 60
SLFT L

If an error message results, see the DTI fault clearing chapter.
- 8 Enable the DTI:
LD 60
ENLL L

DTI cabling

Figures 10 and 11 illustrate DTI cabling with and without an Echo Cancellor.

Figure 10
DTI cabling with Echo Cancellor

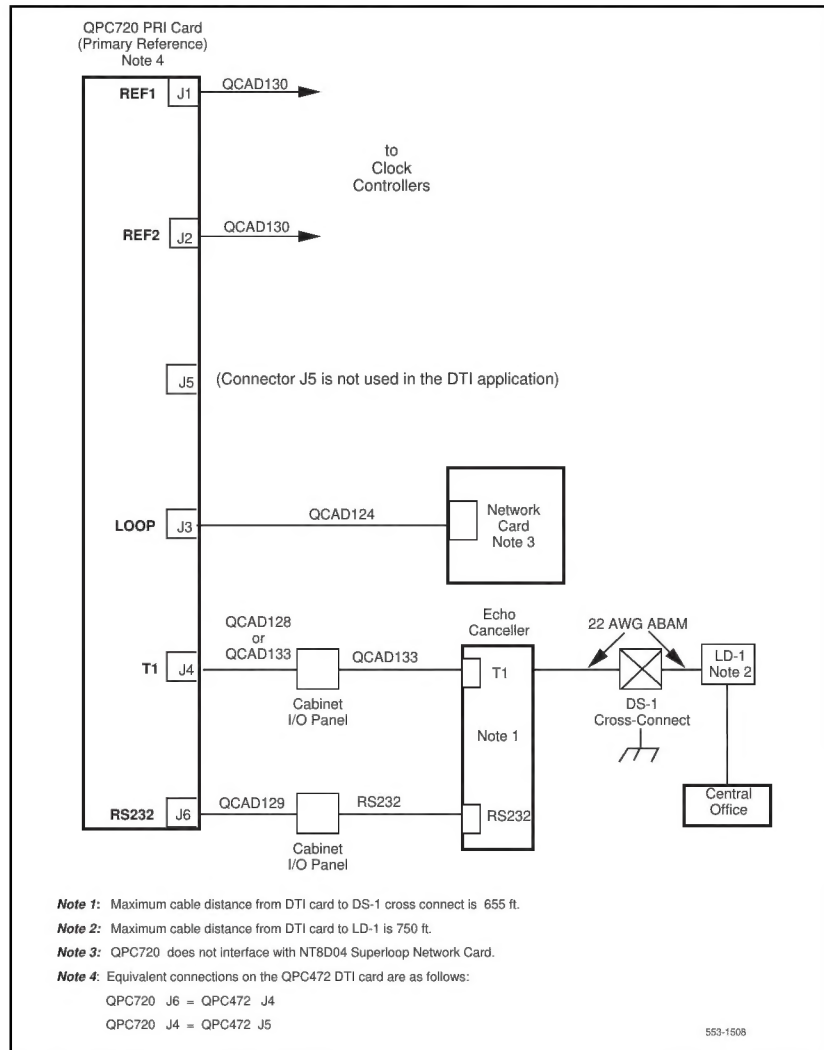


Figure 11
DTI cabling without Echo Canceller

